Exhibit A
McNulty Gulch, Climax Mine

EPA 440/1-75/061
GROUP II

Development Document for Interim Final and Proposed Effluent Limitations Guidelines and New Source Performance Standards for the Ore Mining and Dressing Industry

Point Source Category
Vol. I

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

October 1975

DEVELOPMENT DOCUMENT

for

INTERIM FINAL AND PROPOSED

EFFLUENT LIMITATIONS GUIDELINES

and

NEW SOURCE PERFORMANCE STANDARDS

for the

ORE MINING AND DRESSING

POINT SOURCE CATEGORY

VOLUME I - SECTIONS I - VI

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Because of their frequent use in this document, the definitions of a mine and mill are included here for purposes of recommending subcategorization and effluent limitations guidelines and standards:

Mine

"A mine is an area of land upon which or under which minerals or metal ores are extracted from natural deposits in the earth by any means or methods. A mine includes the total area upon which such activities occur or where such activities disturb the natural land surface. A mine shall also include land affected by such ancillary operations which disturb the natural land surface, and any adjacent land the use of which is incidental to any such activities; all lands affected by the construction of new roads or the improvement or use or existing roads to gain access to the site of such activities and for haulage and excavations, workings, impoundments, dams, ventilation shafts, drainage tunnels, entryways, refuse banks, dumps, stockpiles, overburden piles, spoil banks, culm banks, tailings, holes or depressions, repair areas, storage areas, and other areas upon which are sited structures, facilities, or other property or materials on the surface, resulting from or incident to such activities."

Mill

"A mill is a preparation facility within which the mineral or metal ore is cleaned, concentrated or otherwise processed prior to shipping to the consumer, refiner, smelter or manufacturer. This includes such operations as crushing, grinding, washing, drying, sintering, briquetting, pelletizing, nodulizing, leaching, and/or concentration by gravity separation, magnetic separation, flotation or other means. A mill includes all ancillary operations and structures necessary for the cleaning, concentrating or other processing of the mineral or metal ore such as ore and gangue storage areas, and loading facilities."

Examination of the metal ore categories covered in this document indicates that ores of 23 separate metals (counting the rare earths as a single metal) are represented. Two materials are treated in two places in this document: (1) vanadium ore is considered as a source of ferroalloy metals (SIC 1061) and also in conjunction with uranium/vanadium extraction under NRC licensing surveillance (SIC 1094); and (2) monazite, listed as a SIC 1099 mineral because it is a source of rare-earth elements, also serves as an ore of a

Mine Water

The waste water situation evident in the mining segment of the ore mining and dressing industry is unlike that encountered in most other industries. Usually, most industries (such as the milling segment of this industry) utilize water in the specific processes they employ. This water frequently becomes contaminated during the process and must be treated prior to discharge. In the mining segment, process water is not normally utilized in the actual mining of ores and is present only in placer operations operating by gravity methods, in hydraulic mining, and in dust control. Water is a natural feature that interferes with mining activities. It enters mines by ground-water infiltration and surface runoff and comes into contact with materials in the host rock, ore, and overburden. The mine water then requires treatment depending on its quality before it can be safely discharged into the surface drainage network. Generally, mining operations control surface runoff through the use of diversion ditching, and grading to prevent, as much as possible, excess water from entering the working area. The quantity of water from an ore mine thus is unrelated, or only indirectly related, to production quantities. Therefore, raw waste loadings are expressed in terms of concentration rather than units of production in the ore categories discussed in Section IV.

In addition to handling and treating often massive volumes of mine drainage during active mining operations, metal ore mine operators are faced with the same problems during startup, idle periods, and shutdown. Water handling problems are generally minor during initial startup of a new underground mining operation. These problems may increase as the mine is expanded and developed and may continue after all mining operations have ceased. The long-term drainage from tailing disposal also presents long-term potential problems. Surface mines, on the other hand, are somewhat more predictable and less permanent in their production of mine drainage period. Water handling within a surface mine is fairly uniform throughout the life of the mine. It is highly dependent upon precipitation patterns and precautionary methods employed, such as the use of diversion ditches, burial of toxic materials, and concurrent regrading and revegetation.

Because mine drainage does not necessarily cease with mine closure, a decision must be made as to the point at which a mine operator has fulfilled his obligations and responsibilities for a particular mine site. This point

Exhibit B
McNulty Gulch, Climax Mine

DEVELOPMENT DOCUMENT

FOR FINAL

EFFLUENT LIMITATIONS GUIDELINES AND

NEW SOURCE PERFORMANCE STANDARDS

FOR THE

ORE MINING AND DRESSING

POINT SOURCE CATEGORY

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adjustment and settling, granular-media filtration, etc.). These unit process costs were added to yield total cost at each treatment level. After confirming the reasonableness of this methodology by comparing EPA cost estimates with treatment system costs supplied by the industry, the Agency evaluated the economic impacts of these costs.

After considering these factors, EPA identified various control and treatment technologies as BAT and NSPS. The proposed regulation, however, does not require the installation of any particular technology or limit the choices of technologies that may be used in specific situations. Rather, it requires achievement of effluent limitations that represent the proper design, construction, and operation of these or equivalent technologies.

The effluent limitations for ore mining and dressing BAT and NSPS are expressed in concentrations (e.g., milligrams of pollutant per liter of wastewater) rather than loading per unit(s) of production (e.g., kg of pollutant per metric ton of product) because correlating units of production and wastewater discharged by mines and mills was not possible for this category. The reasons are:

1. The quantity of mine water discharged varies considerably from mine to mine and is influenced by topography, climate, geology (affecting infiltration rates) and the continuous nature of water infiltration regardless of production rates. Mine water may be generated and required to be treated and discharged even if production is reduced or terminated.

2. Consistent water use and loss relationships for ore mills could not be derived from facility to facility within a subcategory because of wide variations in application of specific processes. The subtle differences in ore mineralogy and process development may require the use of differing amounts of water and process reagents but do not necessarily require different wastewater treatment technology(ies).

The Agency is not promulgating pretreatment standards because it does not know of any existing facilities that discharge to POTWs or any that are planned.

Data Gathering Efforts

Data gathering for the ore mining and dressing industry included an extensive collection of information:

1. Screening and verification sampling and analysis programs

2. Engineering cost site visits

chemical means to yield recoveries of over 99 percent. The price of platinum as quoted recently (15 September 1981) on the spot market was $475 per 31.1 grams (1 troy ounce) (Reference 9).

Molybdenum

Production of molybdenum has been, generally, increasing over the past 30 years as illustrated below (References 5, 7, 15, 16, 17):

Year	Metric Tons	Production Short Tons
1949	10,222	11,265
1953	25,973	28,622
1958	18,634	20,535
1962	23,250	25,622
1968	42,423	46,750
1972	46,368	51,098
1974	51,000	56,000
1977	55,484	61,204
1979	65,302	71,984

Since 1974 significant exploration and development has taken place, and production is expected to increase at a higher rate. Production figures are not available yet, but several new operations have begun since 1976, and a number of mines and mills are in the planning and development stages.

As shown in Table III-15, there are six mines involved with molybdenum: three mines are producing now, and three have exploration underway. The three producing mines are: one open-pit in New Mexico, an underground and a combined open-pit/underground in Colorado. One Colorado operation recovers secondary products of tungsten and tin.

The two Colorado mines discharge to surface waters; one by way of a mill water treatment system, the other by way of separate treatment. The New Mexico mine has no discharge because groundwater is not encountered.

All three active mines are associated with flotation mills which are described in Table III-16. The New Mexico facility treats mill water for discharge by primary and secondary settling (two tailings and one settling pond), and aeration for cyanide removal. They are currently experimenting with hydrogen peroxide for cyanide oxidation. The underground/open-pit Colorado operation uses a complex treatment system including settling, recycle, ion exchange, electrocoagulation flotation, alkaline chlorination and mixed-media filtration. The second Colorado mill accomplishes no discharge by total recycle.

TABLE III-15 PROFILE OF MOLYBDENUM MINES

MINE	LOCATION (state)	YEAR OPENED (original facility)	STATUS OF OPERATION	PRODUCT	ANNUAL PRODUCTION (metric tons* of ore mined)	TYPE OF MINE	WASTEWATER TREATMENT TECHNOLOGIES USED	DISCHARGE METHOD	DAILY DISCHARGE VOLUME (m^3 †)
6101	NM	1922	A	Mo ore	5,700,000	OP	None	None	0
6102	CO	1922	A	Mo,W,Sn ore	14,000,000	UG and OP	To mill treatment system		3.8×10^3
6103	CO	1978	A	Mo ore	2,200,000	UG	Settling; flocculants, aeration	To surface	9.1×10^3
6110	ID	1983 (expected)	UD	Mo ore	6.8×10^6 (capacity)	OP	To mill tailing pond	None	0
6111	AK	unk	EXP	Mo ore	na	unk	unk	unk	na
6115	CO	unk	I (old Pb/Zn) EXP	Mo ore	UG	na	None	To surface	na
6165	NV	1980	UD	Mo ore	OP	unk	None	None	0

*To convert to annual short tons, multiply values shown by 1.10231
†To convert to daily gallons, multiply values shown by 264.173
Status code: A – active; I – inactive; S – seasonal; UD – under development; EXP – exploration underway
**These ferroalloy operations are not included in the current subcategorization scheme as shown in Table II-1.

SECTION VIII

CONTROL AND TREATMENT TECHNOLOGY

This section discusses the techniques for pollution abatement applicable to the ore mining and milling industry. General categories of techniques are: in-process control, end-of-pipe treatment, and best management practices. The current or potential use of each technology in this and similar industries and the effectiveness of each are discussed.

Selection of the optimal control and treatment technology for wastewater generated by this industry is influenced by several factors:

1. Large volumes of mine water and mill wastewater must be controlled and treated. In the case of mine water, the operator often has little control over the volume of water generated except for diversion of runoff from surface mine areas.

2. Seasonal and daily variations in the amount and characteristics of mine water are influenced by precipitation, runoff, and underground water contributions.

3. There are differences in wastewater composition and treatability caused by ore mineralogy, processing techniques, and reagents used in the mill process.

4. Geographic location, topography, and climatic conditions often influence the amount of water to be handled, treatment and control strategies, and economics.

5. Pilot plant testing and acquisition of empirical data may be necessary to determine appropriate treatment technologies for the specific site.

6. The availability of energy, equipment, and time to install the equipment must be considered. Selection of BAT by mid-1980 will give the industry three years to implement the technology.

IN-PROCESS CONTROL TECHNOLOGY

This section discusses process changes available to existing mills to improve the quality or reduce the quantity of wastewater discharged from mills. The techniques are process changes within existing mills.

Control of Cyanide

Cyanide is a commonly used mill process reagent, used in froth flotation as a depressant and in cyanidation for leaching.

Recycle of spilled reagent can also be an advantage. At Mill 3101, the occurrence of spills and overflow from flotation cells results from the milling of a higher grade ore than the reagent dosage is optimized for. A system has been implemented to collect spills and return them to the flotation circuit. This control practice not only improves the quality of treated wastewater, but the percentages of metals recovered as well.

Use of Mine Water as Makeup in the Mill

A large number of mine/mill operations use mine drainage as makeup in the mill (e.g., 4103, 4104, 4105, 3101, 3102, 3103, 3104, 3105, 3106, 3108, 3110, 3113, 3118, 3119, 3122, 3123, 3126, 3127, 3138, 3142, 6102, 6104, 9402, and 9445). In some instances, the entire process water requirement of the mill is obtained from mine drainage.

From a wastewater treatment aspect for facilities allowed to discharge, a great advantage is gained by this practice. First, this practice either eliminates the requirement for a mine water treatment system or greatly reduces the volume of wastewater discharged to a single system. As discussed previously, reducing the volume of wastewater flow to an existing treatment system can be an effective means of enhancing the capabilities of that system. Second, in situations where mine water contains relatively high concentrations of soluble metals, its use in the mill provides a more effective means for the removal of these metals than could generally be attained by treatment of the mine water alone. This is due to reduced metals solubility in the alkaline conditions maintained in flotation and most mill circuits. Therefore, use of mine water as makeup in a mill can be considered a control practice which improves the quality of mine and mill treated wastewater.

Techniques for Reduction of Wastewater Volume

Pollutant discharges from mining and milling sites may be reduced by limiting the total volume of discharge, as well as by reducing pollutant concentrations in the wastestream. Volumes of mine discharges are not, in general, amenable to control, except insofar as the mine water may be used as input to the milling process in place of water from other sources. Techniques for reducing discharges of mill wastewater include limiting water use, excluding incidental water from the waste stream, recycle of process water, and impoundment with water lost to evaporation or trapped in the interstitial voids in the tailings.

In most of the industry, water use should be reduced to the extent practical, because of the existing incentives for doing so (i.e., the high costs of pumping the high volumes of water required, limited water availability, and the cost of water treatment facilities). Incidental water enters the waste stream directly through precipitation and through the resulting runoff influent to tailing and settling ponds. By their very nature, the water-treatment facilities are subject to precipitation inputs which, due to large surface areas, may amount to substantial volumes of water. Runoff influxes are often many times larger, however, and may be controlled to a great extent by diversion ditches and (where appropriate) conduits. Runoff diversion exists at many sites and is under development at others.

Complete Recycle - Zero Discharge

Mill Water

Recycle of process water is currently practiced where it is necessary due to water shortage, where it is economically advantageous because of high make-up water costs, or the cost to treat and discharge. Some degree of recycle is accomplished at many ore mills, either by reclamation of water at the mill or by the return of decant water to the mill from the tailing pond or secondary impoundments. The benefits of recycle in pollution abatement are manifold and frequently are economic as well as environmental. By reducing the volume of discharge, recycle may not only reduce the gross pollutant load, but also allow the employment of abatement practices which would be uneconomical on the full waste stream. Further, by allowing concentrations to increase in some instances, the chances for recovery of certain waste components to offset treatment cost--or, even, achieve profitability--are substantially improved. In addition, costs of pretreatment of process water--and, in some instances, reagent use--may be reduced.

Recycle of mill water almost always requires some treatment of water prior to its reuse. However, this most often entails only the removal of solids in a thickener or tailing pond. This is the case for physical processing mills, where chemical water quality is of minor importance, and the practice of recycle is always technically feasible for such operations.

In flotation mills, chemical interactions play an important part in recovery, and recycled water may, in some instances, pose problems. The cause of these problems, manifested as decreased recoveries or decreased product purity, varies and is not, in general, well-known, being attributed at various sites and times to circulating reagent buildup, inorganic salts in recycled water, or reagent decomposition products. In general, plants practicing bulk flotation on sulfide ores achieve a high degree of recycle of process waters with minimal difficulty or process modification. Complex selective flotation schemes can pose more difficulty, and a fair amount of work may be necessary to achieve high recovery with extensive recycle in some circuits. Problems of achieving successful recycle operation in such a mill may be substantially alleviated by the recycle of specific process streams within the mill, thus minimizing reagent crossover and

Molybdenum Mine/Mill 6102

This facility is located in Colorado and employs both open pit and underground mining methods. Approximately 14,000,000 metric tons (15,400,000 short tons) of ore containing molybdenum, tungsten, and tin are processed each year. The ore is beneficiated at the site by a combination of flotation, gravity separation, and magnetic separation methods to produce concentrates of molybdenum, tungsten, and tin.

A daily average of 3,800 cubic meters (1 million gallons) of mine water is pumped from the underground workings to the mill tailing ponds. Three tailing ponds receive the mill tailings discharge, and most of the clarified effluent is recycled to the mill. The system of tailing ponds, impoundment, and extensive recycle has been used to achieve zero discharge throughout most of the year. Heavy snowmelts flowing to the treatment system have necessitated a discharge during the spring of most years. Extensive runoff diversion works have been installed to reduce spring discharge volume. The treatment system includes ion exchange for molybdenum removal, electrocoagulation flotation removal of heavy metals, alkaline chlorination for the destruction of cyanide, and mixed media filtration. A continuous bleed through this treatment system will replace the previous seasonal discharge to limit the required capacity and, thus, the capital costs.

Climax Mine

Full scale operation of the treatment system described above was initiated during July 1978. This treatment system is designed to treat 7.6 cubic meters (2,000 gallons) per minute; however, at the date of sampling, the system had been operated at only 3.8 cubic meters (1,000 gallons) per minute. The following discussion of this treatment system reflects its performance during the first four months of its operation.

The treatment facility houses all the aforementioned unit processes and is located below the series of tailing ponds. Feed for the system is a bleed stream from a final settling pond whose characteristics are presented in Table VIII-60.

The wastewater is treated first in an ion exchange unit (pulsed bed, counter-flow type) to remove molybdenum. This ion exchange unit uses a weak-base amine-type anion exchange resin for optimum molybdenum adsorption. The influent is acidified to approximately pH 3.5, since molybdenum adsorption is reported to be most efficient at a pH in the range of 3.0 to 4.0 (Reference 67). Initial results indicate that an influent molybdenum concentration of 5.6 mg/l is reduced to 1.3 mg/l in the ion exchange effluent. Molybdenum recovery from the eluant (backwash) has not been practiced to date. When the system is optimized, molybdenum recovery is planned. However, several problems with the columns (most notably, excessive pressure at flow exceeding 3.8 cubic meters, or 1,000 gallons, per minute) have impeded the assessment of the actual treatment capability of this unit process.

The ion exchange effluent is treated by electrocoagulation flotation for removal of heavy metals. This process involves the formation of a metal hydroxide precipitate (by addition of lime), which is then conditioned in an electrocoagulation chamber via contact with hydrogen and oxygen gases, generated by electrolysis. The resulting slurry is mixed with a polymer flocculant and floated in an electroflotation basin by small bubbles of oxygen and hydrogen. The floated material is skimmed off and discarded. To date, the effluent from this process has been monitored only for TSS, iron (total), and cyanide. The extent to which these parameters have been removed by the electrocoagulation flotation process is indicated by the following:

	Concentration (mg/l)	
Parameter	Influent to Electrocoagulation	Effluent from Electrocoagulation
TSS	127	65
Fe (Total)	1.8	0.5
Cyanide	0.09	0.04

Climax Mine

Total system effluent monitoring data indicate that effective removal of zinc and manganese is also attained (refer to Table VIII-60). Efficient dewatering and handling of the sludge which results from this process have not been optimized and this problem has not been resolved.

Effluent from the electrocoagulation flotation process is treated by alkaline chlorination for destruction of cyanide and then polished by mixed-media filtration prior to final discharge. The sodium hypochlorite used for the alkaline chlorination is generated on-site by the electrolysis of sodium chloride. The hypochlorite is injected into the waste stream prior to the filtration step. The first four months of data indicate that influent cyanide levels (clear pond bleed) range from less than 0.01 to 0.20 mg/l while the treatment-system effluent concentrations of cyanide range from less than 0.01 to 0.04 mg/l. After the treatment plant effluent passes through a final retention pond (residence time of approximately 2 hours), the cyanide levels are consistently below 0.01 mg/l. The retention pond was added to the system to ensure adequate contact time for the oxidation reaction to occur. Since the system is still in the process of optimization, it is expected that dosage levels for the hypochlorite will be optimized, and that possible problems with high levels of residual chlorine will be eliminated.

Mixed-media filtration was incorporated into the treatment scheme to provide effluent polishing for optimum removal of suspended solids and metals.

Climax Mine

In spite of difficulties which have been encountered the overall performance of the treatment system has been good (refer to Table VIII-61). Plant personnel report that the effectiveness of the treatment system at this time has generally exceeded their expectations based on pilot plant experience.

Aluminum Ore Subcategory

Open-pit Mine 5102 is located in Arkansas and extracts bauxite for metallurgical production of aluminum. Approximately 900,000 metric tons (approximately 1,000,000 short tons) of ore are mined annually at this site. A bauxite refinery which produces alumina (Al_2O_3) in a variety of forms and which recovers gallium as a byproduct is located on site, but no wastewater from the refining operation is contributed to the mine water treatment system. Bauxite mining at this operation occurs over a large expanse of land, and several mines may be worked at one time. Because of the long distance between mine sites, several mine water treatment plants have been constructed. There are three mine water discharge points averaging 10,900 cubic meters (2.8 million gallons) per day, 14,100 cubic meters (3.7 million gallons) per day, and 7,000 cubic meters (1.9 million gallons) per day, respectively. The associated wastewater treatment systems consist of lime addition and settling. Monitoring data for each of the discharges are presented in Tables VIII-62 through VIII-64. Each of the three discharges consistently meets BPT daily average and monthly maximum total suspended solids concentrations.

Mine 5101 is an open pit mine located adjacent to Mine 5102 in Arkansas. Bauxite is mined at this facility for the production of metallurgical aluminum. Approximately 900,000 metric tons (1,000,000 short tons) of ore are mined yearly. The ore is hauled directly to the refinery. There are presently three active discharge streams with separate treatment systems employing similar treatment technologies. Lime addition and settling are used to treat the acid mine drainage of Mine 5101. Portable, semi-portable, and stationary treatment systems are all currently being used at this mine. Monitoring data for each of the discharges are presented in Tables VIII-65 through VIII-67. Each of the discharges consistently met BPT limitations for total suspended solids and aluminum during the monitoring period.

Tungsten Ore Subcategory

Tungsten Mine/Mill 6104

This operation is located in California in mountainous terrain at elevations of 2,400 to 3,600 meters (8,000 to 11,000 feet). A complex tungsten, molybdenum, and copper ore is mined at the rate of 640,000 metric tons (700,000 short tons) per year. A large volume of mine water, 38,000 m³ (10 million gallons) per day, flows by gravity from the portal of this underground mine.

severely short circuited. For this reason, the use of a number of small ponds in series serves to reduce hydraulic surges, offset short circuiting and reduce the velocity of flow, thereby improving conditions for removal of settleable solids. Also, some miners use sluice box tailings to construct dikes between several ponds in series. In passing from one pond to another, the wastewater must filter through these dikes. This practice provides very effective removal of settleable solids in most instances.

Multiple-settling pond systems have been used at placer Mines 4114, 4133, 4136, 4138, 4139, 4140, and 4141. Screening devices to classify paydirt prior to washing or sluicing have been used at placer mines 4133, 4136, 4138, and 4141. As indicated in Table VIII-79, all of the placer mines which employ multiple ponds and screening were capable of producing a treated effluent having less than 1.0 ml/l/hr of settleable solids. Mine 4142 also employs two ponds in series; however, these ponds were being short circuited and, as a result, were not as effective as they could have been.

A report prepared for the State of Alaska, Placer Mining Wastewater Settling Pond Demonstration Project, confirms that in theroy and practice, for settling placer mine wastewater discharges, an effective holding time of four hours of quiescent settling will reduce settleable solids to below detectable levels. For a pond to provide the equivalent of four hours quiescent settling, the pond generally must be designed for a holding time of more than four hours.

Control of Mine Drainage

It is a desirable practice to minimize the volume of water contaminated in a mine because the volume to be treated will be less. Best practices for mine drainage control result from careful planning and assessment of all phases of mining operations. Mining techniques used, water infiltration control, surface water control, erosion control, and regrading and revegetation of mined land are all essential considerations when planning for mine drainage control. In the past, inadequate planning resulted in a significant adverse impact on the environment due to mining. In many instances, extensive and costly control programs were necessary.

The types of mining operations (planned or existing) used to recover metal ores differ in many respects from those of the coal mining industry. This is important to note when considering the information available on mine drainage control in these industries. Mine drainage problems in the coal industry appear to be more widespread than those in the metal ore mining and dressing category. This is primarily because of the number of mines involved, geographic location, age, disturbed area, and geology of the mined areas. There is an abundance of literature describing the problem of mine drainage from both active and abandoned coal mines. The discussions which follow present the limited available information on mine drainage control in metal ore mines. However, references to practices employed in coal mining operations which may be applicable to metal ore mining are also presented.

Water-Infiltration Control

Diversion of water around a mine site to prevent its contact with possible pollution forming materials is an effective and widely applied control technique. Flumes, pipes, ditches, drains, and dikes are used in varying combinations, depending on the geology, geography, and hydrology of the mine area. This technique can be applied to many surface mines and mine waste piles.

Regrading, or recontouring, of some types of surface mines, and surface waste pile can be used to modify surface runoff, decrease erosion, and/or prevent infiltration of water into the mine area. There are many techniques available, but they are highly dependent on the geography and hydrology of the land and the availability of cover or fill materials. This practice, along with the establishment of a stable vegetative cover, is currently being used experimentally at one eastern metal ore mine to decrease erosion and stabilize soil on an abandoned waste pile. Use of regrading techniques at the larger open-pit mines may be limited only to the disturbed area surrounding the pit or to stabilization of some steep slopes.

Mine sealing techniques and procedures for sealing boreholes and fracture zones are more frequently applied to inactive or abandoned mines. Internal sealing by the placement of barriers within an underground mine can be used in an active mine with caution. Mine sealing practices are used either to prevent water from entering a mine or to promote flooding of an abandoned mine to decrease oxidation of pyritic materials. No data on the use or efficiency of mine sealing techniques in the metal ore mining and dressing industry were available for use in this report.

Control Practices in the Ore Mining and Dressing Industry

Most of the metal-ore mines examined in this report (both underground and open-pit) practice some measure of mine drainage control. These practices involve controlled pumping of mine drainages and application of a variety of treatment technologies, or use in a mill process. Use of mine water as makeup water in mill circuits is a desirable management practice and is widely implemented in this industry. In many areas of the West, water availability is limited, and water conservation practices are essential for mine/mill operations. Mine water which has been adequately treated is suitable for discharge to surface waters, and this practice is also common to this industry.

Exhibit C
McNulty Gulch, Climax Mine

Mi
Permit No. CO-0000248
Application No. CO-075-OYR-2-000239

* AUTHORIZATION TO DISCHARGE UNDER THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of the Federal Water Pollution Control Act, as amended, (33 U.S.C. 1251 et. seq; the "Act"),

AMAX Inc.

is authorized to discharge from a facility located at Climax, Colorado,

to receiving waters named East Fork, Ten Mile Creek,

in accordance with effluent limitations, monitoring requirements and other conditions set forth in Parts I, II, and III hereof.

This permit shall become effective on the date of issuance.*

This permit and the authorization to discharge shall expire at midnight, December 31, 1978.

* Signed this 31 day of December, 1974

for John A. Green
Regional Administrator

New

*Thirty (30) days after the date of receipt of this permit by the Applicant.

EPA Form 3320-4 (10-73)

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (Continued)

4. During the period beginning July 1, 1977, and lasting through December 31, 1978, the permittee is authorized to discharge from outfall serial number 001, subject to additional conditions of Part III, Section H.

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations				Monitoring Requirements	
	Mass		Concentration			
	Kg/day(lbs/day) Daily Avg.	Kg/day(lbs/day) Daily Max.	mg/l Daily Avg.	mg/l Daily Max.	Measurement Frequency	Sample Type
Flow - m^3/Day (MGD)	N/A	44028 (11.6)2/	N/A	N/A	Daily/Continuous	1/
Total Suspended Solids	N/A	N/A	N/A	25	Weekly	Grab
Total Molybdenum	182(400)	454(1,000)	N/A	N/A	Weekly	Grab
Total Iron	N/A	N/A	N/A	2.0	Monthly	Grab
Total Zinc	N/A	21.0 (43.1)	N/A	0.5	Biweekly	Grab
Total Manganese	N/A	N/A	0.25	1.0	Monthly	Grab
Total Cadmium	N/A	0.63 (1.4)	N/A	0.015	Quarterly	Grab
Cyanide	N/A	1.1 (2.4)	N/A	0.025	Biweekly	Grab
COD	N/A	N/A	20	30	Monthly	Grab
Fluoride	N/A	N/A	N/A	N/A	Monthly	Grab
Total Copper	N/A	2.2 (4.8)	N/A	0.05	Monthly	Grab
Total Lead	N/A	4.4 (9.7)	N/A	0.1	Monthly	Grab

Oil and grease shall not exceed 10 mg/l in a single grab sample and shall be monitored monthly with a grab sample.

The pH shall not be less than 6.0 standard units nor greater than 8.5 standard units and shall be monitored daily with a grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

In addition to the above limitations, total annual discharge of molybdenum shall not exceed 14,075 Kg/yr (31,000 lbs/yr).

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): See Part III, Section G.

1/ Weir, flume or other accepted instrument or technique.
2/ Additional limitations on flow, Part III, Section H

B. SCHEDULE OF COMPLIANCE

*

1. The permittee shall achieve compliance with the effluent limitations specified for discharges in accordance with the following schedule:

   (a) Interceptor canals shall be completed and operational no later than the dates indicated in the following schedule:

(1)	Chalk Mountain	July 1, 1975
(2)	East Interceptor	December 31, 1976
(3)	West Interceptor	July 1, 1976
(4)	Clinton Interceptor	December 31, 1976
(5)	All other diversions	December 31, 1976

   (b) Progress reports on the construction and operation of diversion structures shall be submitted to the permit issuing authority semi-annually. The first report shall be due on February 1, 1975.

2. Following completion of the studies required under Part III, Section A, the permittee shall submit to the permit issuing authority no later than July 1, 1975, an implementation plan for an abatement program designed to achieve the effluent limitations specified in this permit for discharge from outfall(s) #001. The implementation plan shall consist of an outline of intended design, construction and operation, including a compliance schedule setting forth the dates by which compliance with the effluent limitations will be reached. The compliance schedule shall include, where appropriate, dates to accomplish the following:

   (a) completion of preliminary plans
   (b) completion of final plans
   (c) award of contract(s)
   (d) commencement of construction
   (e) completion of major construction phases
   (f) completion of all construction
   (g) attainment of operational level no later than July 1, 1977

A. MANAGEMENT REQUIREMENTS

1. *Change in Discharge*

All discharges authorized herein shall be consistent with the terms and conditions of this permit. The discharge of any pollutant identified in this permit more frequently than or at a level in excess of that authorized shall constitute a violation of the permit. Any anticipated facility expansions, production increases, or process modifications which will result in new, different, or increased discharges of pollutants must be reported by submission of a new NPDES application or, if such changes will not violate the effluent limitations specified in this permit, by notice to the permit issuing authority of such changes. Following such notice, the permit may be modified to specify and limit any pollutants not previously limited.

2. *Noncompliance Notification*

If, for any reason, the permittee does not comply with or will be unable to comply with any daily maximum effluent limitation specified in this permit, the permittee shall provide the Regional Administrator and the State with the following information, in writing, within five (5) days of becoming aware of such condition:

a. A description of the discharge and cause of noncompliance; and

b. The period of noncompliance, including exact dates and times; or, if not corrected, the anticipated time the noncompliance is expected to continue, and steps being taken to reduce, eliminate and prevent recurrence of the noncomplying discharge.

3. *Facilities Operation*

The permittee shall at all times maintain in good working order and operate as efficiently as possible all treatment or control facilities or systems installed or used by the permittee to achieve compliance with the terms and conditions of this permit.

4. *Adverse Impact*

The permittee shall take all reasonable steps to minimize any adverse impact to navigable waters resulting from noncompliance with any effluent limitations specified in this permit, including such accelerated or additional monitoring as necessary to determine the nature and impact of the noncomplying discharge.

5. *Bypassing* (See additional requirements under PART III)

Any diversion from or bypass of facilities necessary to maintain compliance with the terms and conditions of this permit is prohibited, except (i) where unavoidable to prevent loss of life or severe property damage, or (ii) where excessive storm drainage or runoff would damage any facilities necessary for compliance with the effluent limitations and prohibitions of this permit. The permittee shall promptly notify the Regional Administrator and the State in writing of each such diversion or bypass.

OTHER REQUIREMENTS (Continued)

4. Reports required above shall be submitted to the parties and addresses noted in Part I, Section C. 2., of this permit.

B. Additional Effluent Limitations

There shall be no discharge of pollutants into the East Fork Eagle River, the East Fork Arkansas River or tributaries thereto from the permittee's facility.

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C. Exclusions

All point source discharges carrying runoff or snowmelt that are unaffected by disturbed areas within the permittee's facility and contains no process wastewaters shall be excluded from the effluent limitations and monitoring requirements of Part I, Section A.

Disturbed areas shall be defined as the areas disturbed by the permittee's operations including, but not limited to areas from which overburden has been removed, or on which it has been deposited, ore stockpile areas, milling and auxiliary facilities, tailings deposition areas and all other nonpublic areas or facilities.

D. Additional Requirements

The permittee shall maintain and operate all interceptor ditches and canals and other diversions in accordance with Part II, Section A. (3) of this permit.

E. Purge Notification and Operation

1. The permittee shall notify the permit issuing authority a minimum of twenty-four (24) hours prior to the initiation of a purge from the tailings pond. The purge shall be necessitated solely from excess water in the system resulting during spring snowmelt. Any other excessive dis-